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(54) Name of Invention: Oil Impregnated Electrical Machinery

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Specifications

1. Name of Invention

Oil Impregnated Electrical Machinery

2. Scope of the Patent Claims

Oil impregnated electrical machinery which uses as electrical insulation oil an oil mixture in which 1 or 2 or more types of aryl phenylethane electrical insulation oil with the following structural formulae

[please refer to the original for the formulae]

to which 55vol% or greater rapeseed oil or soy bean oil, which are vegetable oils, is added.

3. Explanation of the Details of the Invention

Field of Industrial Use

This invention is one which relates to oil impregnated electrical machinery which uses flame resistant electrical machinery insulation oil, and which is safer in terms of fire prevention.

Hithertofore Technology

Hithertofore, mixtures of 1 or 2 or more types of aryl phenylethanes with the following formula are used as electrical insulation oil (hereinafter referred to as insulation oil) in oil impregnated electrical machinery such as condensers, cables, transformers, et cetera.

[please refer to the original for the formula]

(A) PTE

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[please refer to the original for the formula]

(B) PEPE

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[please refer to the original for the formula]

(C) PCE

[please refer to the original for the formula]

(D) PXE

[please refer to the original for the formula]

(E) PDEPE

Although this aryl phenylehtane is used mainly in condensers as an alternative oil to biphenyl chloride insulation oil, unlike biphenyl chloride, it is not non-flammable, but rather it is actually a flammable oil.

Problematic Points the Invention Attempts to Resolve

In recent years, there has been a stricter than ever re-examination of the fire prevention policies for electrical machinery, and the need to make flame resistant the electrical machinery insulation oil used in oil impregnated electrical machinery has been heightened.

Procedures for Resolving the Problematic Points

This invention is that which offers oil impregnated electrical machinery which uses flame resistant insulation oil in which flammability characteristics have been improved by means of the combination of *55vol%* or greater of rapeseed oil or soy bean oil, which are vegetable oils, to the afore described aryl phenylethane.

Embodiment

The following is an explanation, which is based on experiment data, of this invention.

Figure *1* is the combustion portion of the test equipment which is used in the oxygen index method flammability test; *1* is a glass column; *2* are glass beads contained within the glass column *1*; *3* is glass tubing with a *3mm* inner diameter such that one end is housed in the glass column *1*, and the other end connected with oil reservoir *4*; this oil reservoir *4* and the glass tubing *3* are filled with oil *5*. The drain is *6*, and it is connected with the glass tubing *3*, with a cock *8* installed at the location of such connection. Also, *7* is a drain which is attached at the location of the oil reservoir *4*. The flame is *9*.

The flammability of the insulation oils was tested using the oxygen index method, with which it is possible to quantitatively determine flammability.

The oxygen index method entails using oxygen and nitrogen with which to adjust the oxygen contained within the atmosphere of the combustion portion, and then to obtain the minimum oxygen concentration at which the insulation oil will ignite and continue to burn.; it is a method in which that [oxygen concentration] is indicated as the oxygen index. It is used as the flammability test method for macromolecular material (*JIS K 7201*); shown in Figure *1* is a

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[translation of page "18" continued from 2/4]

version of the measurement equipment modified for use with liquids, which was used in which the oxygen index for combustion and *3* minutes of sustained burn were measured.

The oxygen index of the afore described aryl phenylethane was in the range of *18.5 ~ 20*; when the oxygen concentration of the air is *21* or less, it indicates that it will combust in the air. On the other hand, the oxygen indices of rapeseed oil and soy bean oil, which are vegetable oils, are at *26.5 and 27.0* respectively, both at *21* or higher, and are self-extinguishing oils.

It is anticipated that the combination of this vegetable oil will result in flame resistance.

Figure *2* shows the oxygen index of the oil mixtures when rapeseed oil or soy bean oil is mixed with aryl phenylethane. When rapeseed oil or soy bean oil is mixed with aryl phenylethane, the oxygen index increases; when there is a *55vol%* or greater mixture, it becomes *21* or greater, and it is possible to determine that it becomes flame resistant. Because the viscosity of these vegetable oils is higher than that of aryl phenylethane, the upper limit of the mixture ratio for the rapeseed oil or soy bean oil may be determined taking into consideration the appropriate viscosity for the oil mixture. Also, because these vegetable oils contain chain non-saturated hydrocarbons such as oleic acid, linolic acid and linolenic acid (as an example, a chart of the component fatty acids is indicated), and gas absorption is excellent, but because they are lower than that of aryl phenylethane, this fact may also be taken into consideration in determining the mixture ratio.

Chart

	Rapeseed Oil *(%)*	Soy Bean Oil *(%)*
Palmitic Acid	*4*	*10*
Stearic Acid	*2*	*4*
Oleic Acid	*55*	*22*
Linolic Acid	*22*	*54*
Linolenic Acid	*13*	*9*
Others	*4*	*1*

The rapeseed oil and soy bean oil are of food grade, and in accordance with *JAS* Standards Article *29* and Article *23* respectively; if additionally processed using kaolin, activated aluminum, et cetera, there will further improvement in the total oxygen value of the general

electrical characteristics, and will be that which can be used as insulation oil with no problems.

Effects of the Invention

As described above, if rapeseed oil or soy bean oil, which are vegetable oils, is added at a ratio of *55vol%* or greater to the afore described aryl phenylethane, a flame resistant insulation oil is obtained, and there is the effect of heightened oil impregnated electrical machinery safety.

Also, because food grade oils are used for these vegetable oils, it is needless to say that they are extremely safe in terms of hygiene.

4. Simple Explanation of the Figures

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Figure *1* is an explanatory diagram of the combustion portion of the equipment which is used in the oxygen index method flammability test; Figure *2* is a graph of the characteristics of the oxygen index; it indicates the flammability of the oil mixture based on mixture ratios of aryl phenylethane with the vegetable oils.

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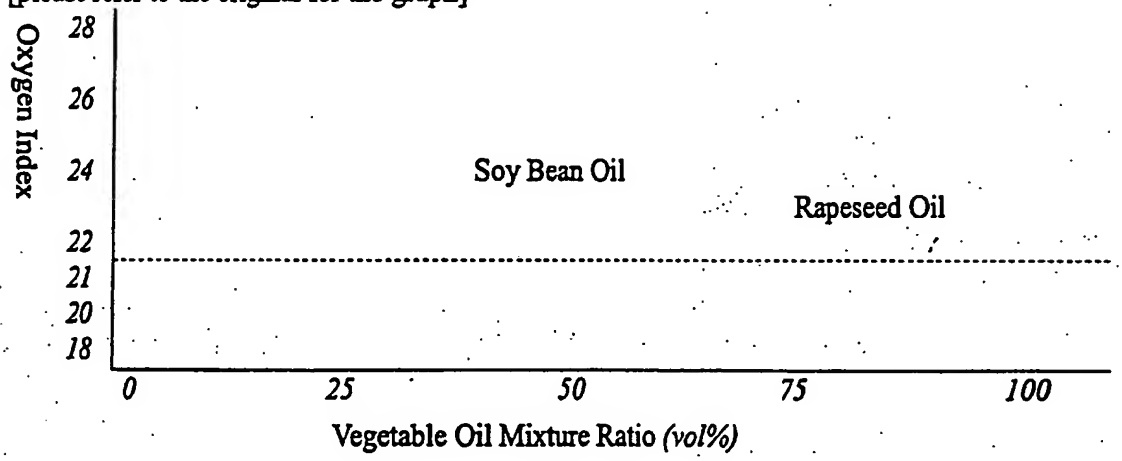
Figure *1*

[please refer to the original for the drawing]

9 Flame
3 Glass Tubing (internal diameter *3mm*)
7 Drain
4 Oil Reservoir
5 Oil
1 Glass Column
8 Cock
6 Drain
N_2+O_2 *2* Glass Beads
↑↑↑↑↑↑

Figure *2*

[please refer to the original for the graph]



[Translator's Note: The phonetic reading of the name appearing here (Shigeyoshi Nishikawa) is an educated guess. It is not possible to give a definitive phonetic reading of most names of individuals.]